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ABSTRACT

This report is based on initiatives, investigations, developments and evaluations made over a three year period. The recommendations are made generally to people and organizations who are concerned with the science and mathematics education of young people aged 11 to 16. The intentions of the recommendations were to help teachers and examiners to respond to the challenges of new methods of assessment and curriculum innovations; relate the principles of school science and mathematics to their practical and modern, everyday, applications and to excite the interest of students in these subjects and their importance in industry, commerce, engineering and applied science. The recommendations are clustered under the three areas of: (1) "Structure", (2) "Methods of Collecting and Developing Resources", and (3) "Dissemination of Resources". (PK)

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FINAL REPORT

ON

STUDY OF RESOURCES AND OVERTURE

DECEMBER 1986

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

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Robert H. Gammon

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

FOREWORD

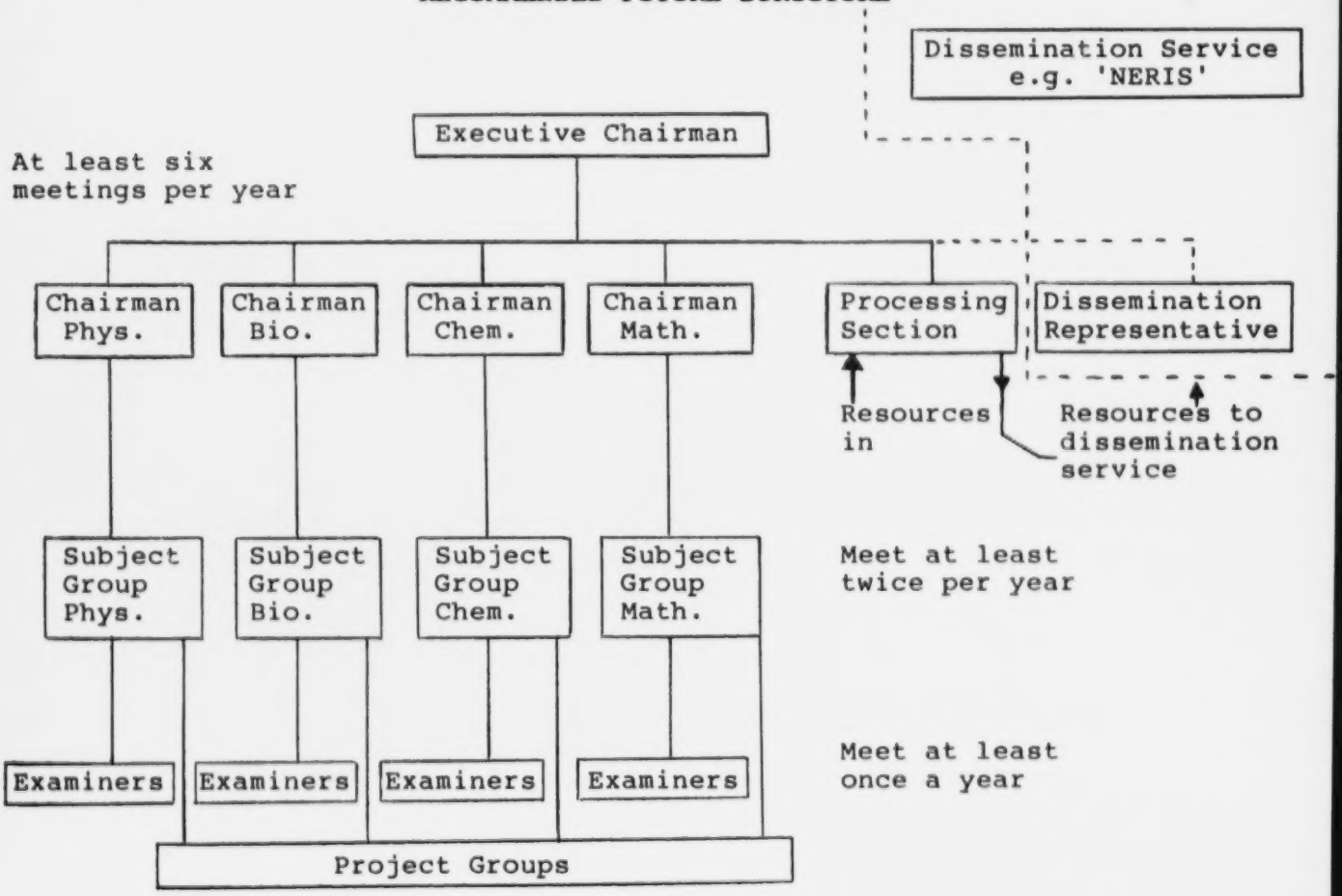
This Final Report is based on initiatives, investigations, developments and evaluations made during the three year period of the **'Study of Resources'** and **'Overture'** centred on the ***terms of reference** agreed with the Industry/Education Unit of the Department of Trade and Industry at the outset.

The **recommendations** arising from this experience are made generally **to people and organisations who are concerned with the science and mathematics education of young people, aged 11-16,** but more specifically to Government Departments, Senior Industrialists, Local Education Authorities and others **with the power and influence to ensure the recommendations are acted upon.**

The network of contacts, the enthusiasm, experience and expertise of the people involved, together with the systems developed for the production and electronic dissemination of information, have provided an increasing flow of resource items of rising quality, **for immediate use by teachers,** which must be sustained.

This is a time of rapid change in both educational and technological terms. The intentions are to help teachers and examiners to: respond to the challenges of **new methods of assessment (GCSE) and curriculum innovations (TVEI, CPVE);** to relate the principles of school science and mathematics to their practical and **modern, everyday, applications** and **so excite the interest of students in these subjects** and their importance in industry, commerce, engineering and applied science.

RECOMMENDED FUTURE STRUCTURE



*see page 13

Note: The Appendix is published separately (see inside back cover)

SUMMARY RECOMMENDATIONS

We recommend that the following are set up in order that the fullest potential benefits be derived from the 'Study of Resources' and 'Overture' in the interest of the science and mathematics education of students aged 11-16.

A. STRUCTURE

1. Executive Chairman	-	a full time appointment to provide the vital administrative and development focus
2. Chairmen's Group	-	to preserve the integrated development and efficient dissemination of resources
3. Processing Unit	-	to ensure resources are: made available to teachers without delay; complete and accurate; kept up-dated; revised in response to feedback
4. Subject Groups	-	to maintain momentum; stimulate and finance resource production; make sure teachers get the services they want; respond to GCSE and other changes
5. Examiners' Workshops	-	to support examiners in responding to new demands in the assessment of young people's abilities and achievements

B. METHODS OF COLLECTING AND DEVELOPING RESOURCES

1. Resource Types	-	to provide for all students the full range of resources identified by the Study in response to SEC/GCSE and other proposals
2. Methods of generating new resource items	-	to maintain the existing methods, explore others, evaluate and revise them
3. Network of producers	-	a wealth of experience and expertise now exists; the network should be preserved and extended
4. Contacts (industrial and others)	-	central and regional organisations can facilitate action at the local levels
5. Interactive database	-	vital to the widespread availability of resources; a stimulus for producers of such items

C. DISSEMINATION OF RESOURCES

1. Electronic dissemination	-	considered to be the only way in which resources can be continually produced, adapted, updated, reflect technological change as it occurs, excite interest of young people
2. In-Service Training	-	a vital element in the efficient use of the computerised database and resources, and in the production of resources
3. Updating	-	data, processes, information change rapidly; updating is vital
4. Cost Effectiveness	-	the database can provide a vast array of teaching materials quickly, economically and efficiently

A. STRUCTURE

1. Executive Chairman

During the course of the Study the Director has been responsible for:

- the establishment, membership, servicing and collective actions of the Chairmen's and Subject Groups
- the contacts with Examinations Boards and Examining Groups and the organisation and follow up to the Examiners' Workshops
- the administration and financing of the 100 or so regional groups around the United Kingdom from which resources flow
- the publicity for the Study and Overture; the production of periodic reports, resources packages, pamphlets and articles; the building up of a directory of several thousand people, who wish to become actively engaged in the ongoing work
- presentations and demonstrations about the Study and Overture at conferences, seminars and working groups
- the establishment of contacts with industry, professional bodies and learned societies e.g. Secondary Examinations Council, The Royal Society, Secondary Science Curriculum Review
- the general work, research and evaluation related to the terms of reference for the Study
- the overall targets set for the production of resources, the trialling and entry of the items onto the database 'Overture'
- the provision of a central focus for administration, enquiries, contributions, exchange of ideas and programmes with other projects.

We recommend that a full-time Executive Chairman is appointed to ensure the continuity of this work through:

- **the activities of the Chairmen's Group**
- **the activities of the Subject Groups**
- **the funding and production of resources by individuals and working groups in close association with industry**
- **the nationwide distribution of these resources, working closely with the Processing Unit and Dissemination Agency (NERIS)**
- **continuing liaison with Examining Groups and the organisation of Examiners' Workshops**
- **the provision of a recognisable focus for the ongoing work in science and mathematics but available for co-ordinating the work of other subject areas of the school curriculum.**

2. Chairmen's Group

The Chairmen's Group proved to be the power-house of the Study. It included the Study Director and the Chairmen of the Subject Groups.

The functions of the Group have been to:

- ensure free exchange of ideas, joint development and action, collective approaches to people of influence
- approve the equitable allocation of funds to people and groups; stimulate the production of resources; collect, edit and trial materials; establish standards
- respond to the requirements of the changing curriculum and examinations; explore the types of resources needed in teaching methods, assessment and the ability range of the students
- make the work known as widely as possible; draw people in to help; integrate science, mathematics and other subjects through the topic-centred database.

We recommend that the Executive Chairman, the Chairmen of Subject Groups and representatives of the Processing Unit and Dissemination Agency make up the new Chairmen's Group and should meet on a regular basis (a minimum of six times a year) to:

- **make and review policy decisions**
- **allocate funds to the Subject Groups**
- **ensure a continuing integrated approach (we stress the value of this interdisciplinary approach and recommend similar inter-subject links in other curriculum areas be developed)**
- **avoid wasteful duplication of effort and ensure broad coverage of subject areas**
- **maintain a consistent approach to the quality and standard of resources generated**
- **continue to establish and strengthen links with industry, professional bodies and education**
- **organise the collection and trialling of resources**
- **generate new ideas for resource production**
- **maintain the activity and enthusiasm of the Subject Groups**
- **establish and maintain good liaison between the Subject Groups, Processing Unit and Dissemination Agency**

3. Processing Unit

The work for which the establishment of a Procesing Unit is being recommended has been identified from the experience of developing and practical use of the Study's computerised database 'Overture'.

The research programme undertaken by the 'Overture' team included:

- the form in which resource items be best provided; the design of header sheets; the guidelines on copyright; more recently, the inclusion of graphics
- the establishment of a computerised database, with British Telecom, through which the first and second phase trials of the Study's resources and the workings of a national dissemination system were completed
- the provision of training; the issue of hardware and software for the trial centres; the supervision of the trials
- the final checking of resource items for completeness and accuracy; how best this can be carried out
- frequent presentations and demonstrations of 'Overture' at many centres throughout the country to stimulate interest and assess demand
- the adaptation of 'Overture' resources for inclusion on NERIS.

We recommend that a Processing Unit be set up to provide the final vital link between the producers of resources, especially of original items, and the Dissemination Agency.

The functions of the Unit should be to:

- **liaise with the Dissemination Agency to ensure that the resources are made available to teachers efficiently and without delay**
- **liaise closely with the Subject Groups through their Chairmen and to provide the computer database expertise in the production and provision of resources**
- **ensure the resources include all the information a teacher will require and check the final accuracy of that information**
- **maintain a consistent format for the resources to facilitate the search for relevant items by the teachers**
- **establish ways in which data and information can be up-dated at suitable intervals**
- **respond as necessary to the feedback from the users of the database.**

4. Subject Groups

The Subject Groups have included practising schoolteachers, local authority advisers, HMI, industrialists, colleagues from further and higher education and professional institutions. Many brought extra knowledge and experience to bear through their membership of other bodies such as the Secondary Examinations Council, Association for Science Education, Secondary Science Curriculum Review, Mathematics Education and Industry, TVEI.

Groups were established originally for separate science and mathematics to parallel the structure of the Secondary Examinations Council and gain maximum benefit from teacher expertise in the limited time.

During the course of the Study the Groups have developed a common collective responsibility to:

- stimulate the production of resources through personal contacts and knowledge of existing potential sources, leading regional groups, generating and exchanging ideas through brainstorming
- set up working links between industry and education within the Groups and more widely
- reflect the changes in the methods of assessment and examining through contacts with the examination system and the provision of a programme of Examiners' Workshops
- monitor and trial the content of the resources produced (identify gaps, ensure full spread of ability, avoid bias, maintain accuracy and high quality); respond to the needs and demands of teachers.

We recommend that Subject Groups should form a core element of future development and extension of the Study activities in order to:

- **maintain the momentum and contacts developed during the past three years especially in the production of resources in subjects for which teacher shortages exist**

- **continue to respond to the needs of schools and industry (We foresee the need for yet closer integration of the Subject Groups and the establishment of a balanced mathematics/science group with eventual extension to other subject areas)**

- **strengthen further the links with the Examining Groups, their Subject Officers and Chief Examiners through the Workshops and other activities**

- **ensure modest, but adequate, funding be available to facilitate the local work shared by teachers and helpers from outside the schools in the production of resources.**

The membership of the Groups should be reviewed from time to time to ensure balanced representation. Experience suggests 12 as the optimum membership and a level of funding of £10,000 per annum for each Subject Group would cover travel, meeting expenses and resource production by regional groups. The potential return in terms of resources of immediate use in the classroom promises to be very cost effective.

5. Examiners' Workshops

One of the major reasons for the Study at the outset was the recognition of the profound influence examinations and the associated syllabuses have on the curriculum provided for students aged 11-16.

From the beginning the Study and Overture have endeavoured to respond to the recommendations of the Cockcroft Report Mathematics Counts, the Secondary Examinations Council, the DES and others.

Examiners' Workshops have been an important feature in the development of the Study. The added close co-operation and generous support of the Examination Boards and Examining Groups has enabled examiners to:

- develop the various modes of assessment using the industry-related resources provided by the Study (this has been particularly important in view of the publication of the GCSE proposals)
- visit various industries and thereby produce assessment items which highlight the social, economic, technological and environmental aspects of science and mathematics
- meet and discuss with representatives of various industries the content and types of examination questions and modes of assessment
- work with examiners from other Examining Groups (Boards) in the drafting, shredding and final production of assessment items
- have the opportunity to act collectively in response to the introduction of GCSE
- gain experience in the use of a database of resources e.g. Overture and NERIS.

We recommend that such a vital evolving programme should be continued and quickened while the GCSE is being introduced into schools.

The Examiners' Workshops should continue to:

- **provide the collective opportunities and services already established for examiners**
- **respond to changing demands made on examiners and teachers in the assessment of young people's abilities and achievements**
- **identify the continual needs of examiners in the writing of examination questions and assessment items and provide through a database (NERIS)**
  - **information**
  - **ideas**
  - **data**

  which are up-to-date and around which examiners can work
- **draw on the help afforded by industrial and higher education colleagues in order to respond promptly to recent developments in engineering and technology.**

B. METHODS OF DEVELOPING AND COLLECTING RESOURCES

1. Resource Types

The early work of the Subject Groups of the Study identified the need for seven major types of resources to support the teachers in the implementation of the GCSE proposals for science and mathematics.

They are:

a) **practical applications to illustrate the science and mathematics curriculum**
   - everyday and, where possible, modern ways in which the principles of school science and mathematics are employed

b) **problem solving exercises and ideas**
   - opportunities for young people to work either singly or in teams to solve problems and develop ideas on the basis of their school work and free from the time restraints of examinations

c) **practical assignments**
   - experimental work to investigate and develop science and mathematics principles related to the evolving syllabus e.g. in biotechnology or design

d) **projects**
   - longer term investigations involving design, make and test

e) **coursework tests (school assessment)**
   - set periodically to assess progress and understanding of the principles and techniques of science and mathematics. Varying modes of assessment leading towards GCSE

f) **examination questions (practice questions)**
   - the introduction of new style questions possibly requiring the student to apply knowledge to unfamiliar situations in readiness for externally set examinations; questions to stimulate interest in the subjects

g) **data presentation and interpretation**
   - data of many different sorts and its presentation
   - interpretation of data to gain accurate and useful information
   - use of data to determine trends and influences (updated on the database).

Some 5000 resource items across these seven types will have been produced during the period of the Study. There will be an expanding and increasing need for such resources as the database becomes more widely known and used.

We recommend a positive effort must be made to ensure the continuing flow of such items through practical support for the Subject Groups.

Equally rapid response should be possible to demands for new forms of resources e.g. software.

2. Methods of Generating New Resource Items

One of the major demands on the Study was to investigate ways in which resources, sought by teachers and examiners and of direct and immediate use, might be best produced.

The following methods for resource production have been explored:

a) **Individuals undertaking original resource development**
   - based on teachers' special interests; adaptation of existing teaching materials and ideas for wider use; development of syllabus principles in application contexts

b) **Home-based resource production**
   - the involvement of skilled and experienced teachers temporarily out of the classroom (mothers with young children) and engineers and scientists similarly placed or recently retired

c) **Twinning of industry and teachers**
   - benefiting from the active interest of colleagues in industry and commerce by identifying teachers to work with them from the large number of volunteers (2500+) who live or teach in the same vicinity

d) **Liaison with other curriculum development groups** (ASE, SSCR, TVEI, MEI, BST (Trent), CIA, CEE, LEA, groups - see Appendix: 4)
   - many such groups have created or are developing teaching resources which can be adapted for the database
   - abstracts, reviews and information about availability, cost etc. can be provided in a structured way related to syllabus content

e) **Collection of published resources** (BP, STEEL, SATRO, BBC - see Appendix: 4)
   - industrial educational services, organisations in the industry/education liaison field, the BBC and others have either produced resources for schools or built up collections (libraries) of such items from many sources
   - regional projects have been set up to investigate ways in which teachers can benefit from such collections by cataloguing, abstracting and producing suitably structured resource items

f) **Working teacher groups producing original resources** (often based on Higher Education institutions or LEA Centres)
   - some such groups have been established by the Study with some modest financial support; others were formed by independent initiatives
   - all produce resources with immediate use in the classroom in mind
   - the inclusion of the resources (adapted for direct use or referenced) on the database provides opportunities for their use nationally; in return the resources of other Groups become available to the local producers

g) **Examiners' Workshops**
- examiners from different Examining Groups working collectively and with others from industry to produce items as listed on page 7
- resources often include straight information about modern industrial processes, production and other data, ideas around which questions might be built

h) **Examiners' visits to industry**
- specialist subject groups (physics and mathematics) and mixed groups of examiners have visited a wide range of industries
- major elements of the visits were to identify the practical applications of school science and mathematics around which to frame questions, problem solving exercises, practical assignments and project ideas
- valuable data, process details, plant layouts relating to the visits were provided and adapted for the database
- some continuous work has been undertaken by a group of Chemistry Examiners in the North East (NICE)

i) **Equipment suppliers**

It is important that teachers possess, or are able to obtain easily, the equipment needed to perform practical work associated with a specific resource item
- to ensure this, investigations have been carried out into the ways in which suppliers can be provided with advance information about demands for equipment (new or existing) as resources come on stream
- the database will need to highlight such new resource items and the suppliers will need to monitor the database continually
- the suppliers have carried out very valuable development work (experiments, kits, publications) in response to curriculum change; such information should appear on the database as straight information (catalogue items), abstracts, work cards etc.

j) **Abstracting journals and projects**

Experimental abstracting services have been established to determine the feasibility of providing such a service in a suitable form for teachers
- a cross-section of journals (New Scientist, View, School Science Review, Physics Education, Education in Chemistry, Journal of Biological Education etc.) are being abstracted for the database; the hard-pressed teacher can seek out references in an ordered way
- similar services have been provided in the past and the existing abstracts are being reviewed and adapted
- many publications including details of projects have been produced in the past; these have been reviewed and the themes added to those of projects of more recent origin

k) **Refereeing and appraisal** (publications not commonly used in schools)
- publications and books outside the usual school text-book list may carry sections which are pertinent to developments of new syllabus material
- such publications have been refereed and information provided in terms of content, costs, availability

1) **Resources competition**
   - this was intended to explore a competitive way of encouraging the production of resources by individual teachers and students, or by groups
   - generous prizes of computer systems and equipment vouchers have been provided by industry (see Appendix: 4)

m) **Resources Package**
   - this provides information about the Study and Overture, guidelines for the production of resources, sample resources, header sheets, copyright information and an invitation to help
   - several thousand packages have been distributed
   - in return steady streams of offers to help and draft resource items flow into the Study

n) **Links with resource developers outside the U.K.**
   - several overseas contacts have been made through visitors working with our project groups or through other personal contacts
   - exchange of resource items between countries has been explored and is ripe for development.

The stringent evaluation of these various ways of producing resources was prevented by two factors. The first, the teachers action, reduced the level of activity in the regional groups. The second, the removal of the Study's interactive database at the start of the crucial third and final development stage of 'Overture' meant that the value and stimulus of a live computerised system with which the groups should have worked was lost.

Most of the methods employed depend on the provision of some funding. Large sums of money are not involved but small grants have enabled the Study to benefit greatly from the voluntary time and effort provided by teachers and colleagues in support of them.

We recommend that these methods be pursued further, an evaluation be carried out once NERIS can provide the interactive database and that the funding be made available through the Subject Groups (see page 5).

3. Network of Producers

During the Study a wide range of resource producers have co-operated in the generation of resource materials (see Appendix: 3).

Experience has shown that such a network is capable of generating a wide variety of materials, many produced by the direct co-operation of industry and commerce. This network is unique and would be very difficult to re-establish if it is allowed to collapse.

We recommend that the continuation and expansion of this network be given the highest priority.

4. Contacts

Important contacts have been established with a wide range of organisations (see Appendix: 4).

The continued successful generation of resource materials will rely heavily on these. It is imperative that active co-operation be continued.

5. Importance of Interactive Database

Trials of the Overture database demonstrated that an interactive system providing access to original resource items was welcomed by the teaching profession. It was also found that such a database was vital in the stimulation of the production of resource items. It was unfortunate that at a critical stage of the Study this facility was lost causing serious problems both for users and resource producers. This also severely restricted the development phase of the Study designed to build on the successful trials of the resources through the database.

It is crucial that an efficient dissemination system (such as NERIS) ensures the widespread availability of these resource materials to users and developers alike.

C. DISSEMINATION OF RESOURCES

1. Electronic Dissemination

As early as November 1984 proposals recommending electronic dissemination of resources had been made to the IEU (see Appendix: 2). These highlighted the ability of such a system to:

a) provide access to up-to-date information on a given subject in terms of curriculum projects, data and available resources;

b) disseminate such information into the school or classroom in full-text form, immediately on demand;

c) provide users with a facility for linking with others in the network to exchange information, experiences and ideas;

d) enable the classroom use of IT techniques to be developed in terms of information retrieval and data handling;

e) enable the users to interact with the system by commenting on ideas and material, or by placing their own material on the database;

f) be copyright free, enabling teachers to copy and adapt the resouces to their own needs.

The trials of the Overture database have shown that such a system is feasible. It is recommended that in order to ensure the resource materials maintain both their relevance and accuracy of information electronic dissemination should be the only method pursued.

2. In-Service Training

The Study has shown that in-service training both for using an electronic dissemination system, and developing resource materials in a format suitable for such a system is essential.

We recommend that training in the use of the system be undertaken by the dissemination agency. Training in the production of resources should be carried out under the guidance of the Subject Groups.

3. Updating

It has become clear during the Study that one of the major advantages of an electronic dissemination system is in maintaining a bank of up-to-date resources. Other advantages identified include the ability to modify resources to cope with changes in current data and to provide resources based around topical events and new industrial processes.

For the above reasons we recommend that the dissemination agency provides a rapid updating service to resource providers. In addition we feel it would be valuable for users of the database to be able readily to identify recently added resources.

4. Cost Effectiveness

The Study has shown that a large number of effective resource materials can be developed for a comparatively small investment. At a difficult time for the education system many teachers gave their time freely in order to co-operate in the production of resource items. Indications are that many teachers would welcome a continuation of such involvement in the future.

It is inconceivable that such an offer could be ignored.

The trials of the Overture database have shown that electronic dissemination is a highly cost effective means of getting new resources into the hands of the classroom teacher. Indications are that with similar usage to trial centres the average cost in telephone charges could be around £30 per term.

It is recommended that the dissemination agency makes a concerted effort to point this out to the education service.

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Terms of Reference (January 1984)

The terms of reference of the 'Study of Resources' were to:

a) survey existing resources in relation to current school courses and examination, look for gaps and take initiatives to fill them;

b) examine the best forms in which to provide the resources;

c) ensure that resources and information are available freely and disseminated effectively on a nation-wide basis;

d) pay particular attention to the needs of examiners and methods of assessment alternative to the conventional written examination.

Notes:

a) The proposals of the Secondary Examinations Council (GCSE) created fresh gaps and needs for new style resources during the period of the Study.

b) The general forms of the resources are many, varying from straight text to video programmes. In the strict context of the dy the resources are of seven forms suitable for inclusion on th. electronic database 'Overture' but capable of providing information about the comprehensive range of teaching materials.

c) Early in the period of the Study it was decided that a ectronic database 'Overture' and dissemination system (British Te.ecom) would be used exclusively so avoiding duplication of the work of others.

d) The Examiners' Workshops have proved a success in taking the early steps towards meeting the demands of GCSE.

'Study of Resources' and 'Overture'

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Frank Hunt
Steve Leighton
Pat Cross

Please Note

The Study Director and the Group Chairmen would be happy to discuss the work of the past three years and the recommendations for the future.

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APPENDIX

The Appendix to this Final Report is published separately and includes:

1) Outline description of the Study. R. H. Gammon.

2) National Educational Resources Information Service (NERIS). A computerised system available to schools (A Development Paper). D. J Bevan, Nov. 1984.

3) Study Groups (a list of contributors to the Study).

4) Contacts and Acknowledgements.

5) References.

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